

The History of Water Quality Improvement in Moses Lake

The improvement of Moses Lake's water quality has been a long and gradual process of which many residents and lake users are probably unaware. The first attempt came in 1963 to improve the lake's state from hypereutrophic (highly over-nutrient enriched), which included intense, odiferous and often toxic blooms of blue green algae, that covered the lake surface with floating scums greatly reducing lake clarity. Clint Connelly, board chairman of the Moses Lake Irrigation and Rehabilitation District (MLIRD), contracted with Professor Robert Sylvester, Civil Engineering, University of Washington, to assess the lake's condition, the cause(s) for its degraded state and recommend procedures to improve its quality.

Prof. Sylvester had recently worked with the City of Seattle to institute the addition of low-phosphorus (P) city water to Green Lake to improve its quality. City water P concentration was very low at 6 ppb (parts per billion), while P in eutrophic Green Lake was 65 ppb (over 30 ppb is eutrophic). Addition of 0.9 - 2.4 lake volumes of city water per year subsequently lowered lake P to 20 ppb, which led to greatly improved water quality - much less algae, especially blue greens, and greater water transparency. Sylvester figured that Columbia River water (CRW) with low P (20 ppb) might be used, within the existing irrigation facilities, to dilute the high P concentration in Moses Lake, which was more than double that in Green Lake.

Eutrophication had become recognized as a national problem in the 1960s and the Federal Water Pollution Control Administration (FWPCA) considered Moses Lake an excellent opportunity to demonstrate an effective method to improve the quality of a hypereutrophic lake. So in 1968, the FWPCA awarded a grant to UW Civil Engineering for a project entitled "Eutrophication Control by Flushing", which unfortunately turned out to be an inappropriate term to describe the lowering of lake P concentration by routing high volumes of low-P CRW through the lake. As a result, the project did not proceed due to perceptions raised by the term "flushing". Nevertheless, the lake's existing water quality and external nutrient inputs were monitored for two years by UW personnel that defined its hypereutrophic (over 100 ppb P) state existing in 1969 and 1970 that subsequently helped obtain funding for the lake's remediation.

MLIRD continued to pursue measures to improve the lake's quality by contracting with UW Civil Engineering to investigate sources of external P inputs to the lake from Crab Creek, Rocky Ford Creek, sewage effluent and internally from the lake's sediment. These and earlier (1969-1970) findings were important in obtaining funds from EPA and through the State (Washington DOE) for a Clean Lake Project giving dilution another chance. That project was carried out by Brown and Caldwell Engineers in cooperation with UW Civil Engineering and MLIRD.

Routing Columbia River water during spring-summer through Moses Lake to supply downstream irrigation use was not new, but quantities had been relatively small between 1956 and 1976, replacing on average only about one fourth of half the lake's most affected volume (Parker Horn, lower lake and main arm to Connelly Park). But a new pattern began in 1977 when USBR directed more water from the East Low Canal to Parker Horn through Rocky Coulee Wasteway and Crab Creek. During 1977-1988, low-

P (phosphorus) Columbia River water replaced on average two half-lake volumes per year. The distribution of CRW entering Parker Horn to half the lake's volume was known because its chemical character was distinctive and detectable.

Dilution greatly improved water quality on average during that 12-year period, compared to 1969-1970; P decreased from 154 to 69 ppb, algal mass, indicated by the pigment chlorophyll, dropped from 57 to 29 ppb and water transparency increased from 0.8 to 1.4 meters in half the dilution-affected lake. The Clean Lake Project goal was 50 ppb P. Dilution was considered successful, even though the lake was still eutrophic (over 30 ppb P), but not hypereutrophic.

Treated sewage effluent was diverted from middle Pelican Horn in 1984. That resulted in a large decrease in P concentration in that Horn from about 920 ppb to 77 ppb. However, algal mass remained high and transparency was low, because P was still too high, likely due to continued recycling from sediment. A pump station was installed in Upper Parker Horn, as part of the Clean Lake Project, to transport Columbia River water to Upper Pelican Horn. That pumped CRW was enough to replace the volume of upper and middle Pelican Horn about 11 times during spring-summer. These two measures, along with CRW through Parker Horn, lowered P in South Lake to 41 ppb and a chl of 16 ppb during 1986-1988 - a 74% and 62% decrease, respectively, since the Clean Lake Project began. Lake quality improved further but it was still eutrophic.

Inputs of CRW continued at an even greater rate from 1989-1995 replacing nearly four half-lake volumes on average during spring-summer. However, there was no comprehensive monitoring of water quality, although it was likely quite good given the quantities of CRW delivered. CRW inputs declined during 1995-1999, averaging the least amount since the project began in 1977 - about 1.5 half-lake volumes, and P concentrations were rather high near the lake outflow at 70 ppb (USBR data).

CRW inputs were up in 2001 at over four half-lake volumes during a comprehensive monitoring effort by WA DOE. Water quality was the best yet with P at only 17 ppb, chl at 11 ppb and transparency of 2 meters, which represented a mesotrophic state (less than 30 ppb P). Moreover, feedback of P from bottom sediments had disappeared. That internal source averaged 33% of the total P loading during the 1970s and 1980s.

CRW input has continued at the rate of 4 half-lake volumes since 2007 with an outlet P concentration averaging 19 ppb over the nine years; that's mesotrophy. Inputs were down 25% during 2016, outlet P was up a little to 32 ppb and there were noticeable accumulations of algal scums along the lake shore. However, the average P of 19 ppb since 2006 represents nearly a 90% improvement since the lake's hypereutrophic condition that existed before the Clean Lake Project. Moses Lake is the most successful case in the world for lake recovery by dilution and its continued improved quality is a tribute to MLIRD and USBR.

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